Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	)	WT Docket No. 06-150
	)	
	)	
Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band	)	PS Docket No. 06-229
	)	
	)	
Amendment of Part 90 of the Commission's Rules	)	WP Docket No. 07-100

COMMENTS OF CASSIDIAN COMMUNICATIONS, INC.,
AN EADS NORTH AMERICA COMPANY
TO THE THIRD REPORT AND ORDER
AND FOURTH FURTHER NOTICE OF PROPOSED RULEMAKING

INTRODUCTION

Cassidian Communications, Inc., an EADS North America Company, ("Cassidian") submits the following comments in response to the Further Notice of Proposed Rulemaking in the above captioned proceeding. Cassidian fully supports the Federal Communications Commission's ("Commission") efforts to produce and clarify rules necessary to ensure our nations first responders can utilize to the fullest extent a 4th Generation nationwide interoperable wireless broadband network based on the 3GPP Long Term Evolution (LTE) platform that provides a variety of mission critical features, services, and applications that can only be accomplished with high bandwidth connections. The ability to operate and be supported "in the field" with mobile wireless broadband voice, video, dispatch, and other critical control room services will enhance the safety of our nations public safety users.

Cassidian is a leading provider of full-circle security and communications

solutions, offering the industry's most comprehensive portfolio of proven solutions, including: TIA-102/Project 25 digital land mobile radio, next-generation applications for NG9-1-1 call processing, incident & records management, computer-aided dispatch (CAD), incident mapping, data management, and notification solutions, as well as training, technical support and a full suite of managed services and professional services.

Cassidian has significant practical experience in all aspects of mission critical communications, having designed and deployed more than 200 digital land mobile radio networks in over 68 countries, including 45 of the most sophisticated and technologically-complex nationwide land mobile radio networks in the world. In addition, Cassidian call center and notification solutions serve over 200 million U.S. residents throughout North America.

In 2008, PlantCML® was acquired by EADS North America, a leading supplier of solutions for defense and homeland security, commercial aviation, helicopters, telecommunications and services, and subsequently integrated with EADS Secure Networks land mobile radio operation. The combined organization, now branded as Cassidian Communications, is part of the overall EADS North America operation, which includes companies and divisions located in 32 cities and 17 states, and contributes more than $11 billion to the U.S. economy annually, supporting 200,000 American jobs.

OVERVIEW

Cassidian applauds the Commission's efforts to create a single technology path for public safety broadband networks operating in the 700 MHz band and the selection of 3GPP LTE Releases 8, 9, and 10 as the focus for this proceeding. A single broadband air

interface based on completely open standards will foster competition, interoperability, and realization of the Commission's and Public Safety's goals for cost effective devices for public safety and public safety mission critical users. The LTE platform offers a full mobility "last mile" solution, enabling broadband access from the field and, thus, a full complement of applications residing on user devices. Similar to the applications enjoyed by commercial users today, LTE will provide unprecedented mobile access to various law enforcement specific data bases, facilitating more efficient field operations and improved situational awareness.

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COMMENTS OF CASSIDIAN COMMUNICATIONS, INC.

I. DEFINITION OF INTEROPERABILITY

In the Commission's discussion of the Forth Further Notice of Proposed Rulemaking ("Forth Further Notice") the Commission seeks comment on the Commission's harmonization of the Commission's definition of interoperability with DHS' definition of interoperability.

> "Interoperability should allow any user while at home or while roaming to be able to access any regional or tribal public safety network in order to reach any other users and any services at home network or at visited network. Interoperability can only be achieved by defining common sets of features and parameters at various communication layers, on every device or node in all networks. Interoperability between devices and network nodes is achieved when all communication layers function with the same corresponding protocols, or simply speak the same language."

Cassidian suggests the following distinction between technical and tactical interoperability:

> "Interoperability should allow any wireless or wired user while at home or while roaming to be able to access any regional or tribal public safety network in order to reach any other users and any services at home network or at visited network. Interoperability can only be achieved by defining common sets of features and parameters at various communication layers, on every device or node in all

networks. *Technica*l interoperability between devices and network nodes and between nodes themselves is achieved when all communication layers function with the same corresponding protocols, or simply speak the same language. *Tactical interoperability between users, agencies, and network operators is achieved with appropriate service level agreements (SLAs), features, and training on operational aspects, particularly in times of crisis, of the network.*"

Cassidian further notes that to achieve interoperability at technical and tactical levels will require engineering rules and appropriate governance to be proposed and developed.

II. SHOULD THE COMMISSION'S DEFINITION OF INTEROPERABILITY BE USED FOR BROADBAND AND NARROWBAND AND IF NOT, WHAT ARE CORRECT DEFINITIONS FOR BROADBAND AND NARROWBAND INTEROPERABILITY

Cassidian believes either the FCC or the Cassidian amended definition for interoperability equally applies to narrowband and broadband systems and operations.

III. TECHNICAL RULES FOR THE PUBLIC SAFETY BROADBAND NETWORK (§ IV.A)[1]

A. Architectural Framework and Architectural Guiding Principles (§ IV.A.2; ¶ 18 - ¶22)

Cassidian comments there are various ways the architecture of the evolving public safety broadband network of networks can progress. The support of an evolving network

[1] To assist the Commission in tracking sections of the Notice to which Cassidian has responded, a section reference from the Notice is added to appropriate headings in this document. Thus (§ IV.A.2; ¶ 18 - ¶22) means Section IV.A.2, Paragraphs 18 through 22. In most cases a paragraph reference is not needed due to the brevity of the section.

would be to use roaming principles and interfaces as defined by 3GPP. Due to the scaling problems and cost of arranging the broad array of roaming agreements for adjacent and overlapping agencies, however, Cassidian feels it is important to envision large regional networks serving as roaming brokers. Such an institution can, for example, be arranged at the state level. Due to the magnitude of a national network rollout, deployment of a nationwide public safety broadband network will occur first in major population centers and, as these networks grow, will aggregate into larger regional, statewide, multistate, and ultimately national network. It can be envisioned that some areas may implement a regional or tribal network underneath the umbrella of a national network.

Cassidian supports the all-IP LTE technology platform (3GPP standard), Universal Terrestrial Radio Access (E-UTRA), Release 8 (LTE), and associated Evolved Packet Core (EPC) as adopted in the 3rd Order and 4th Notice of Public Rulemaking ("Notice") as a foundation, but emphasizes that the foundation adopted by the Commission and resultant rules must be capable of evolving in synchronization with the work by 3GPP to continue the evolution of LTE (e.g. Release 9, 10, etc.). In the Notice, the Commission emphasizes roaming with commercial networks, but the commercial networks could evolve at a different rate than the public safety LTE network, inhibiting seamless delivery and provisioning of broadband services. Thus, Cassidian feels that the ultimate goal is a national public safety network.

Cassidian comments that "support of minimum level of spectrum efficiency" is fixed by the selection of LTE technology and that further improvements are not inherent within a given release.

Cassidian also comments that "support of minimum level of coverage reliability

(95%)" in principle is a good target but further work is needed to make sure critical elements such as indoor coverage are addressed.

i. Nationwide Services and Capabilities (§ IV.A.3; ¶ 23)

Cassidian comments there is no issue to support services, applications and capabilities across multiple networks and that access to all applications is possible whether in one's home network or roaming.

ii. Evolution (§ IV.A.2; ¶ 24)

The Commission comments on the establishment of "guiding principles for public safety broadband network architecture and, if so, whether the principles summarized above are the principles that should serve as the basis for this vision" The Commission also asks if there are other principles to be considered, and "how to best maximize network efficiencies by sharing network resources such as core networks". The Commission further asks "should shared infrastructure also be encouraged through such a vision in order to reduce costs of network deployment." Cassidian responds that ultimate resource sharing avoids duplication of the same functionalities for organizational reasons. Cassidian envisions the most efficient resource usage with one nationwide system. Resource sharing with commercial providers, such as sites, towers, and backhaul infrastructure does not have to be specified in the architecture but is, in fact, an operator business decision. Resource sharing of network equipment elements and transport links with commercial operators can also be left for the deployment and implementation stages, provided that mission critical KPIs will be supported by the SLAs. In the case of fragmented operation of the public safety broadband network, it may be advisable to address the mission criticality KPIs and template SLAs by an entity such as ERIC or the

PSST.

Finally Cassidian feels the best approach for maintaining coherency between different regions/areas is to promote the architecture where there is one nationwide operator responsible for technology selection and deployment.

B. Open Standards (§ IV.A.3; ¶ 27)

Cassidian confirms the Commission's goal of only supporting open standards to prevent implementation of proprietary technology elements that frustrate fundamental interoperability. Cassidian is the only provider of all three open standard public safety mission critical radio systems; TIA-102/Project 25, TETRA, and TETRAPOL and can state confidently that fully open standards foster competition and deployment.

C. Technology Platform and System Interfaces (§ IV.A.4)

Cassidian acknowledges that LTE releases are backwards compatible, but allowing the public safety LTE network to lag more than a release or two behind commercial operators offering will tie the available services and interoperability to the "lowest common denominator". The difference in services may not meet the needs of public safety users, particularly if their services when roaming are minimized. Cassidian further notes that to ensure interoperable voice, i.e. not just data over LTE, the selection of the voice system technology and voice codecs has to be jointly developed by industry and users.

Due to the lack of IPV4 addresses, and to achieve a uniform (nationwide) network, IPV6 will have to be supported. REL8 EPC and user devices (UEs) already support both, and the HSS is managing the UE capacity (only IPV4 capable or only IPV6

or both.). Thus IPV4 AND IPV6 are required to be supported in the LTE infrastructure due to legacy backbone evolution from IPV4 to IPV6. Terminals will have to be both compliant and capable as soon as available. Cassidian feels the cost of (LTE) infrastructure should not be seriously impacted by IPV6 support, and it is the choice of each operator (and likely dependent on the commercial operator whose backbone network may be leveraged) to evolve the backbone and LTE infrastructure to IPV6.

Regarding the Commission's question, "although the prevalent tunneling protocol in LTE is GTP-based, a PMIP-based tunneling protocol has also been specified in 3GPP Release 8", Cassidian supports GTP as the most unified protocol to be used, for reason of homogeneity of the EPC transport, and simplification of network policy management. PMIP requires much more complexity within the infrastructure and may impact roaming interoperability when UEs move from one LTE network to another (i.e. from/to GTP to/ from PMIP). Handover to 2G or 3G may also be difficult to support. Cassidian also notes that PMIP may be not supported by all LTE EPC and UE vendors. Finally, the only interest for an operator to use PMIP is to have a common PGW/ASN to IP WAN such as WIMAX, but PMIP may be much less cost effective solution than GTP. In conclusion, Cassidian's recommendation is to require GTP mandatory and PMIP as an option. Note that all operators and providers will not support PMIP, even in the case of IPV4/IPV6 roaming where stacks and protocols are different. For terminals, having only GTP is much simpler to manage and, for infrastructure, policy management is homogeneous.

D. System Identifiers (§ IV.A.5)

The Commission notes that in "the *Technical Public Notice*, Alcatel-Lucent,

Motorola and DC propose a hybrid scheme in which one separate PLMN ID would be assigned to each regional or tribal network and a single PLMN ID would be assigned for the overall nationwide network. The PSCR has also expressed support for such a scheme." Cassidian supports these commenter's hybrid proposal for assignment of PLMN IDs.

E. Roaming Configurations (§ IV.A.6)

Cassidian supports the Commission's assertion that both home-routed and local breakout roaming be supported. Cassidian further notes that neighboring commercial cells must be known by the PS network in order to be announced in the SIB (standard System Information Blocks broadcasted by each cell as defined in 3GPP TS 36.331)[2] delivered on PS network cells. Obviously connectivity is required between both EPCs (PS and commercial) to facilitate handovers.

F. Interconnectivity of Regional or Tribal Broadband Networks (§ IV.A.8)

The Commission proposes three alternatives for interconnection of Regional or Tribal networks; direct, public internet, or third party network operators. Cassidian comments that the method utilized will be based on the network option availability, bandwidth availability, network QoS, and cost among other factors. Regional and Tribal Broadband Networks may chose to implement two or more of the options due to a need

[2] SIB System Information Block. The System Information (SI) is broadcast in SIBs, each of which contains a set of functionally-related parameters. In LTE, the SIB types include: the Master Information Block (MIB), which contains a limited number of the most frequently transmitted parameters which are essential for a UE's initial access to the network; SIB1, which contains parameters needed to determine if a cell is suitable for cell selection, as well as information about the time domain scheduling of the other SIBs; SIB2, which includes common and shared channel information; SIB3 - SIB8, which include parameters used to control intra-frequency, inter-frequency and inter-Radio Access Technology (RAT) cell reselection. See 3GPP TS36.331 Sections 6.2.2.7 and 6.3.1.

or desire for network redundancy.

Direct connection offers the best control, guaranteed access, high QoS, low latency, and high availability but requires a high initial investment and continuing operating expenses throughout the life of the network. Direct connection may be limited to adjacent or overlying networks where a need

Use of the public internet offers lower costs, limited control, no guaranteed access, limited control of QoS, varying latency, and varying availability. Use of the public internet may be considered as a backup for use of direct or third party operators. Additionally the public internet can be used for temporary connections.

Third party operators can offer control, guaranteed access, high QoS, low latency, and high availability based on the service level agreements with the third party operator. Third party operators operate on a fee for services basis but allows the Regional or Tribal Broadband Network operator to avoid certain operating expenses such as system/site maintenance, network renewal, etc.

The Commission should allow Regional or Tribal Broadband Network operators to evaluate the proposed approaches and make operational decisions based on their particular needs.

G. Prioritization and Quality of Service (§ IV.A.9)

Cassidian comments that 3GPP LTE specifications define ARP (Allocation and Retention Priority). The primary purpose of ARP is to decide if a bearer establishment/modification request can be accepted or rejected in case of resource limitation. Fifteen levels of priority (only 4 bits available) are possible with ARP. Cassidian notes from experience that in the context of nationwide networks, fifteen levels

of priority will be a challenge. The 2 bits that define preemption and vulnerability capability definition are acceptable. Cassidian agrees with the general proposal for a "Nationwide Framework for Priority Access and QoS, Example configuration for PS LTE network" made by Alcatel-Lucent in their ex parte presentation of March 17, 2011.[3]

In the case of the QoS Class Identifier (QCI), QCI is used to control packet forwarding treatment at eNodeB scheduler level. The 3GPP LTE specifications define a range of [0 to 255] QCI of which 9 are standardized. The rest of the values are free for defintion of services and thus public safety can expand this capability. Cassidian further notes 3GPP LTE specifications define Access class barring values from 0 to 15 which are stored in the USIM of the device.

- Classes 0-9 randomly assigned to commercial users
- Class 10 -> E911 calls
- Classes 11 & 15 are reserved for network administrative devices
- Remaining classes for Public Safety & NGN GETS users
    - Class 12 – Security Services (police, …)
    - Class 13 – Public Utilities (water, gas, …)
    - Class 14 – Emergency Services (fire, EMT, ...)

Note there are only 3 special Access class values possible for public safety (values from 12 to 14) and this may not be enough for public safety organizations.

H. Mobility and Handover (§ IV.A.10)

Cassidian supports the Commission's conclusion that "each operator's network

[3] See Alcatel-Lucent's Ex Parte presentation "FCC Multi-Party Vendor Meeting Interoperability", March 17, 2011, Slide #6,

must support seamless handover within its coverage region" for "point-to-point" communications (i.e. UE to UE), but that "point-to-multipoint" seamless handover is a serious technical challenge.

Regarding the Commission's question on X2 vs S1 handover, Cassidian feels the X2 mechanism is required since X2 is more efficient for latency since the X2 mechanism does not require a direct link to the eNodeB.

The Commission seeks comment, raising the same questions as above for roaming, that "the case where handover occurs between two eNodeBs from two different neighboring networks. This would be considered roaming. How is seamless handover possible in this situation?" Cassidian responds this situation depends on the degree of connectivity/relationship between both networks and that for LTE it may be possible to imagine two distinct EPCs managing eNodeBs from different networks (e-UTRAN sharing concept). Although competing commercial operators are unlikely to share eNodeB's, public safety operators in neighboring or overlaying jurisdictions may share eNodeB's enabled by the e-UTRAN sharing.

Finally, Cassidian recommends the Commission adopt a minimum speed of 200 km/h be supported for seamless handovers.

Based on 3GPP TS 25.913, section 7.3, mobility across the cellular network shall be maintained at speeds from 120 km/h to 350 km/h (or even up to 500 km/h depending on the frequency band). However, the mobile speeds above 250 km/h represent a special case, such as high speed train environment. Hence, the E-UTRAN shall also support techniques and mechanisms to optimize delay and packet loss during intra system handover.

I. Out-of-Band Emissions and Related Requirements (§ IV.A.11)

The Commission in the Notice states industry comments "on the OOBE limit specified in the *Waiver Order* expressed support for the OOBE limits proposed by the Commission. Cassidian agrees with the Commission's conclusion.

J. Applications (§ IV.A.12)

Cassidian supports access to all applications whether in home network or roaming. To restrict the list of applications or access mechanisms would frustrate innovation as the network deploys. Each public safety broadband network operator is best suited to determine the applications and methods of access their departments require as long as those methods do not negatively affect interoperability. Cassidian notes industry, users, and the Commission should promote a minimum set of interoperable applications; voice (individual, group), messaging (not only data), and VPN services. To achieve a minimum set of applications will require an industry and user consensus to develop standards such that all protocols crossing the radio interface are interoperable, including the choice of supported codecs and their parameters.

Regarding VPN services, LTE combines secure radio path (UE to eNodeB) with domain security of the infrastructure and thus secure delivery of data connectivity service. Putting a VPN solution on top of this will likely be required by organizational/agency unique security requirements, thus there may be a lack of some motivation to share the solution among organizations due to security concerns.

The Commission seeks comment on "other applications"[4], the five applications specified in the *Waiver Order*[5], and the four applications specified by the NPSTC BBTF[6]. Cassidian supports the application recommendations of the Commission and the NPSTC BBTF. SMS is already a standard feature in cellular 2G, 3G, and 4G networks. LMR Gateways will be necessary to maintain interoperability as narrowband push-to-talk mission critical voice systems will be in existence for a very long time into the future. The Commission should require all PS Broadband networks to support a standardized interface with LMR systems, particularly Project 25 digital systems. Cassidian notes there are multiple interoperability platforms from companies such as Cassidian, Cisco, EF Johnson, Harris, Motorola, Raytheon, and Tait, to name a few, that can convert other LMR technologies (i.e. analog) to Project 25[7] digital voice and can provide the voice and PTT floor control via the Project 25 ISSI[8]. Thus, requiring the P25 ISSI as an interface to the PS BB network can provide a common protocol to move the LMR voice into the public safety broadband network.

Support of the stated applications will promote nationwide interoperability but continuing work on standardization of these applications interfaces will be required.

Finally, Cassidian reiterates that it supports access to all applications whether in

[4] (1) Status/Information "SMS-MMS Messaging" and (2) Land Mobile Radio (LMR) Gateway Devices

[5] See Order

[6] NPSTC BBTF Report also identifies four "desired" applications: (1) Location Based Data Capability; (2) One-to-Many Communications across all Media; (3) LMR Voice; and (4) Public Switched Telephone Network (PSTN) Voice

[7] Cassidian, Cisco, EF Johnson, Harris, Motorola, Raytheon, and Tait have participated in several public ISSI multivendor interoperability events starting at APCO 2007. Project 25 (P25) trunked voice calls utilized the P25 ISSI connected to other P25 and analog systems.

[8] Project 25 and Telecommunications Industry Association TIA-102.BACA-A Project 25 Inter-RF Subsystem Interface Messages and Procedures for Voice and Mobility Management Services (ISSI), January 2009 Publication.

home network or roaming. To restrict the list of applications or access mechanisms would frustrate innovation as the network deploys. Each public safety broadband network operator is best suited to determine the applications and methods of access their departments require.

K. Interconnection With Legacy Public Safety Networks (§ IV.A.13)

The Project 25 ISSI (P25 ISSI) provides a standard IP based protocol, using Session Initiation Protocol (SIP[9]) for call setup, call control and call teardown and Real Time Transport Protocol (RTP[10]) for push-to-talk (PTT) floor control for inter-system interoperability. Cassidian as a key contributor to the development of the P25 ISSI can confidently comment that it was designed to facilitate inter-system communications which includes connectivity from narrowband mission critical networks using P25 digital voice coder/decoders (codecs) to cellular architectures. Cassidian can also state the selection of the SIP and RTP protocols was intentional to ensure the narrowband systems interface had a capable protocol such as SIP to allow the management and discovery of voice codecs and media types to ensure all end-points in a managed group can operate on a common codec, facilitating inter-system interoperability. Cassidian was one of several manufacturers of Project 25 mission critical systems and LTE network technology to demonstrate legacy to broadband network interoperability solutions using the Project 25 ISSI at APCO 2010 and IWCE 2011.

Cassidian notes that in the absence of a radio device with a dual air interface that can operate on both an LTE mobile broadband and an LMR network, interoperability

[9] Internet Engineering Task Force (IETF) RFC3261, Session Initiation Protocol , June 2002

[10] Internet Engineering Task Force (IETF) RFC3550, A Transport Protocol for Real Time Applications , July 2003

must be achieved through interoperability gateways which are able to support both voice and data.

Network Gateway (NGW) connects two radio systems together over an IP connection (for instance P25 via ISSI and LTE) and provides the following functions (depending on the architecture):

- Voice Trans-Coding if codecs are different on both networks (IMBE <-> AMR for instance)
- Floor Control protocol adaptation (IMBE voice stream <-> RTCP for instance)
- Encryption/Decryption (in case there is no E2E ciphering or different ciphering on both side)
- Prioritization for Emergencies or Quality of Service (QOS)
- Scalability

L. Performance (§ IV.A.14)

Cassidian agrees with the recommended performance requirements of 256 kb/s uplink and 768 kb/s downlink but questions if 30 days is sufficient time to qualify a network. The performance of a network is achieved by balancing load, adjustment of sector-by-sector coverage, and adjustment of the site/sector parameters. Additionally a PS network deployment typically employs a network "soak" and shake-down periods utilizing non-mission critical users prior to loading the network with mission critical users. Cassidian suggests the Commission set a more reasonable time period of 3-6 months after network acceptance to allow the entities deploying the network time to assemble the data, review the data, make any necessary corrections, retest, and assemble

a final report to the Commission. Cassidian further suggests that the operator be allowed to self-certify on performance and that the reports should be available should the Commission desire to review.

M. Network Capacity (§ IV.A.15)

Site capacity is primarily dependant on the user traffic profile, the coverage area of the site, and the subscriber density of the site. Cassidian agrees with the stated 1.8 b/Hz for a 3 cell site is a correct value to roughly estimate the site bit rate capacity for backhaul requirements. Requiring the potential operators of the system to prove a minimum level of backhaul per site to the Commission places an unnecessary burden on the system operator. Cassidian further notes that available backhaul infrastructure is likely microwave or fiber. Available bandwidth to serve a site using fiber is not an issue and microwave links providing 45 to 155 MB/s are commonly available and do not provide an undue cost restriction for system backhaul. The Commission should only require operators to maintain and provide the design information in response to an inquiry. We finally note that capacity of the network backhaul core is also dependant on the connectivity hierarchy between the different e-NodeBs and the EPC element present in front of the e-UTRAN.

N. Security and Encryption (§ IV.A.16)

Network access security is a key advantage of LTE technology and can be considered as best in class. There is no possibility to by pass the access security from an air link protocol point of view and this also applies to roaming. Cassidian agrees with the Commission's conclusion of requiring the three security features for the network access

security specified in 3GPP TS 33.401.

What is not covered by 3GPP is the end-to-end security aspects (i.e. encryption keys per group of users, etc.) required by certain public safety user groups. At this time, Cassidian envisions end-to-end security will be similar to current public safety narrowband systems (voice and data) where the network is used to deliver encryption keys to the user terminals with over the air rekeying (OTAR) mechanisms or simple manual key loading directly to the UE. The LTE UEs may be impacted by encryption requirements depending on whether the encryption mechanism is an application residing on the UE or is embedded in the UE.

Cassidian also notes that roaming to commercial networks may encounter security issues with communications over untrusted networks and in that case a VPN solution may be considered to secure the applicable traffic (i.e. UE to server or server to UE).

The Commission asks about 3GPP TS 33.210 specifications for network domain security and if those rules should be adopted. Cassidian agrees with the adoption of the TS 33.210 Network Domain Security (NDS) specifications for two main reasons:

1. Support for roaming between operators
2. Support for multiple agencies within one or more operators

Particularly NDS is to be supported between HSSs and policy management.

The Commission further discusses Application Domain Security (ADS) as specified in 3GPP TS 33.102 and TS 31.111, noting ADS is an optional feature and that ADS enhances network security. Cassidian agrees ADS is good practice but there is a cost impact and this should be left to operators to determine their needs to have a distributed applications scheme particularly if required in the national coverage.

Finally the Commission discusses the optional feature for visibility and configurability of security as specified in 3GPP TS 33.102 and TS 22.101 and asks should the Commission adopt these rules. Cassidian comments that visibility may be useful for users but configuration capability by users should be avoided.

O. Robustness and Hardening (§ IV.A.17)

Cassidian agrees that the typical rule for 8 hours of battery backup in conjunction with generator backup for up to 4 days is a reasonable level of protection and must encompass all the network equipment at the site. These criteria assume that technicians can get to the site within that time period with appropriate equipment and spare parts to effect repairs. If other criteria exist (i.e. longer travel time), then these guidelines should be adjusted as necessary. To require implementations in excess of these guidelines and actual operator needs can be cost prohibitive and should be left up to the local jurisdiction. The Commission should allow operators to maintain their design criteria for each site and provide the design information in response to an inquiry.

P. Coverage Requirements (§ IV.A.18)

Cassidian agrees that the Commission should implement population and geographic coverage requirement goals and that the operator must provide this report on request to the Commission. The data for this report is required for coverage and performance testing upon roll-out of the network.

The Commission discusses the coverage requirement implementation and the associated coverage time frames of “40 percent coverage within four years, 75 percent within ten years and 99 percent within fifteen years.” As the Commission notes

commercial operator coverage is driven by population and public safety coverage is driven by population density and geographic requirements. Cassidian responds that it will take many years to deploy the public safety LTE network and that the initial coverage goals are best achieved by leveraging commercial operators current and evolving infrastructure. The result is the public safety LTE network will initially deploy in urban and suburban population density areas first, followed by interstate highways, major secondary highways, and then rural population densities last (a portion of which is covered by the population that resides near interstate and major secondary highways). Recall that the current narrowband public safety systems will be leveraged to provide mission critical coverage and will provide the highway and rural coverage during the LTE deployment. Thus, assuming funding is available, Cassidian agrees with the Commission's recommendation of 40% population coverage within 5 years, 75% population coverage within 10 years, but feels the requirement for 99% population needs to be carefully examined as the incremental cost of LTE infrastructure from 95% to 99% could be significant.

As previously noted, should the Commission make this report a requirement the operator/jurisdiction should be allowed 3-6 months to produce the report.

Q. Coverage Reliability (§ IV.A.19)

Cassidian recommends that 95% coverage reliability is mandatory for outdoor locations (cell edge is 90% in this case). Coverage is not increased with additional spectrum unless the additional spectrum is used to implement underlay cells. Coverage reliability is only increased with improvement to the cell link budget which requires either increased transmit power, lower receive threshold (i.e. improved noise figure), or a

more robust modulation scheme (which is not an option with the selection of LTE). To increase coverage either femto nodes[11] or relay nodes[12] (both mechanisms are included in Release 9 & 10 of the 3GPP LTE standard) could be deployed to improve local coverage in the cell. Obviously buildings and civil infrastructure that are close to the center of a cell site will be afforded good indoor coverage and the same coverage reliabilities must be proposed for indoor locations. For buildings and civil infrastructure located close to cell edge, femto nodes can be deployed directly in the building. As a design guide, outdoor coverage can be designed to meet indoor coverage requirements considering building penetration margins from 10 to 25dB (typical value approximately 15dB) for 700 MHz.

R. Interference Coordination (§ IV.A.20)

Cassidian notes to the Commission that the exchange of information over X2 is needed to transfer info between eNodeBs in order to enable semi-static ICIC (other than staticICIC). Cassidian also notes that the information flow for ICIC is defined and standardized[13], but the ICIC methods and algorithms are not standardized, allowing different manufacturers to implement different solutions. Thus existence of different vendor systems inside a region (e.g. state or tribal regional network) might cause

[11] See http://www.femtoforum.org/femto/pressreleases.php?id=103

[12] Work Item "LTE_Relay", Approved at RAN plenary meeting #46, Dec. 2009 (RP-091434), Leadership: RAN WG1, Rapporteur: Ericsson; two key building blocks (1) LTE_Relay-Core (36.201, 36.211, 36.212, 36.213, 36.300, 36.321, 36.323, 36.331, 36.133) - target completion date December 2010 (RAN 50), and (2) LTE_Relay-Perf (36.133 + RF requirements for RNs - target completion date March 2011 (RAN 51)

[13] Cassidian notes some other ICIC techniques were studied within 3GPP within the scope of Rel-10 (eICIC: enhanced ICIC): time domain techniques through the use of ABS (almost blank sub-frames) were introduced, especially for heterogeneous deployment scenario: these techniques can also be used in a static way (typically for macro-femto scenario where X2 interface is not available) or in a semi-static way (for macro/pico scenario.

problems or non-functionality between the systems in terms of interference cancellation. Cassidian recommends, however, that both static and semi-static ICIC should be provided for.

Cassidian agrees with the Commission that public safety broadband network operators must coordinate with adjacent operators, regardless of whether that operator is public safety or commercial. The present system of self policing that occurs between commercial operators should be applied to the public safety broadband network. Using this system, operators can fall back to the Commission (e.g. ERIC) should a resolution not be achievable between the operators.

S. Incumbent Narrowband Operations (§ IV.A.21; ¶ 83)

The Commission is seeking other technical rules that may be needed to protect the incumbent narrowband operations from harmful interference. Even if it is rightfully claimed as a general principle that each Public Safety broadband operator shall take all technical measures to prevent harming any potentially affected narrowband incumbent, Cassidian offers some guidance to the Commission and public safety broadband operators allowing assessment of the potential risk during the network pre-design stage rather that waiting until actual roll-out for the implementation of protective technical measures.

Cassidian supports the approach stated by State of Colorado, Governor's Office of Information Technology[14] on the tentative use of 22 dBµ contours to deal with relative protection of narrowband and broadband operation when operating in the same frequency band, which would have been the case, should the flexible use of the broadband spectrum

[14] Comments on PS Docket 06-229, State of Colorado, dated November 30 2010

have been mandated, but which actually will the case in the public safety 700 MHz band due to incumbent deployment of narrowband operations, pending resolution of the relocation issues. See Appendix A for further technical discussion.

T. Public Safety Roaming on Public Safety Broadband Networks (§ IV.B)

Cassidian comments that management of roamers is based upon elements such as PLMN ID, APNs, access class, and priority (note this list is not exhaustive). Labeling of roamers such as ""itinerant"", ""interoperability"", and ""response"" will require definition of those roamer classes within the existing access class and priority capabilities of LTE technology and may prove to be overly restrictive. This subject could be addressed by the ERIC.

Cassidian has many years of experience in deploying PS narrowband networks and notes that Service Level Agreements (SLAs) are currently required to ensure roamers into LMR networks fully understand the level of service they will receive. Cassidian agrees with the Commission that SLAs will be required for the public safety broadband networks regardless of how the roamers are classed.

i. Prioritization and Quality of Service to Support Roaming (§ IV.B.1)

Cassidian has many years of experience in deploying PS narrowband networks and can comment with authority that different PS agencies will have different views of the level of priority for their practitioners. A high level priority user in their network is not automatically a high level priority user in a visited system. This issue should be left to the agencies and the SLAs they craft for supported features for roamers.

ii. Applications to Be Supported for Roamers (§ IV.B.2)

The Commission tentatively concludes that public safety broadband networks must support "five applications to intra-system roamers:

(1) Internet access;

(2) VPN access to any authorized site and to home networks;

(3) a status or information "homepage;"

(4) access to responders under the Incident Command System;

(5) and field-based server applications."

Cassidian agrees with the Commission that support for the five listed applications is the minimum requirement for roamers, noting these applications are in line with current applications[15] being considered at the U.S. Department of Commerce – Boulder Laboratories – Public Safety Communications Research Program (PSCR) broadband activity in Boulder, CO.

U. Federal Use (§ IV.C.1 & 2)

Cassidian generally agrees with the Commission that Federal entities be allowed onto the public safety broadband network. To achieve the UE device cost goals envisioned by the users and the Commission, it is necessary to expand the pool of users allowed to purchase the user devices that work on the PS BB network.

V. Testing and Verification to Ensure Interoperability (§ IV.D)

i. Conformance Testing (§ IV.D.1)

The Commission concludes that all user devices should be "subject to

[15] The PSCR (www.pscr.gov) in partnership with the U.S. National Institute of Standards and Technology is working to foster public safety communications interoperability for broadband networks with the "Public Safety 700-MHz Demonstration Network." Reference document "Basic Applications Demonstrations Outline v3.docx" created by the Applications Demonstrations Working Group (ADWG).

conformance testing and seek comment on this tentative conclusion." Cassidian supports the Commission's conclusion and recommends the Commission to refer to the applicable 3GPP TS documents for Radio and Protocol Conformance.[16]

The Commission discusses the conformance testing and certification process for user devices operating in LTE Band Class 14 and that the testing processes "may not be developed as of the release date of this Fourth Further Notice" and the PTCRB is "expected soon to complete development of such a process." Cassidian agrees with the Commission and recommends that the Commission certification process defined for Band Class 14 is the same as the one defined for the commercial frequency bands.

The Commission also seeks "comment on conformance testing for LTE infrastructure equipment." At this time, Cassidian is not aware of any organization formed for this purpose although some entities are doing relevant work in this area.[17]

ii. Interoperability Testing (IOT) (§ IV.D.2)

The Commission tentatively concludes "that public safety broadband networks perform IOT for the LTE roaming interfaces identified in the Third Report and Order above" and noted the following LTE interfaces be IOT tested "prior to deployment of any

[16] TS 36.508 - Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing

TS 36.141 - Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing

TS 36.521-3 - Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing .

TS 36.523-3 - Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) conformance specification; Part 3: Test suites

[17] The MultiService Forum (www.msforum.com) is doing some work in VoLTE interoperability. A VoLTE interoperability event in partnership with the GSM Alliance (GSMA) is currently planned for September 12-30, 2011.

RAN equipment":

- Uu – LTE air interface
- S6a – Visited MME to Home HSS
- S8 – Visited SGW to Home PGW
- S9 – Visited PCRF to Home PCRF for dynamic policy arbitration.

Cassidian agrees with this list as a minimum requirement but recommends the addition of the following interface to the list above:

- S13 - MME, EIR

Cassidian further comments that, as long as the public safety specific interfaces are part of 3GPP standard REL8 (or above), IOT requirements should be validated for any provider of LTE infrastructure to public safety operators. An IOT Statement of Compliancy on any standard 3GPP interface required by FCC should be provided to any LTE provider as a consequence of the normal commercial testing and should not create extra charges for public safety.

The Commission states in the Notice that "commercial network operators rely on IOT to ensure multi-vendor interoperability for devices and equipment that operate on their networks" and that the LTE interfaces relevant to multi-vendor interoperability include:

- S1-u – between eNodeB and SGW
- S1-MME – between eNodeB and MME
- S5 – between SGW and PGW
- S6a – between MME and HSS
- S10 – between MMEs

- S11 – between MME and SGW
- SGi – between PGW and external PDN
- X2 – between eNodeB and eNodeB (for intra-network handover)
- Gx – between PGW and PCRF (for QoS policy, filter policy and charging rules)
- Rx – between PCRF and AF located in a PDN
- Gy/Gz – offline/online charging interfaces

Cassidian agrees with the list offered by the Commission but suggests the addition of the following interface:

- Uu Terminal to infrastructure

The Commission asks if IOT rules should be required "to ensure multi-vendor interoperability on public safety broadband networks"; "What are the potential costs and benefits of such a requirement?"; and "Does the preceding list include all of the interfaces on which IOT should be required to support multi-vendor interoperability or are there other interfaces that should be included?" Cassidian responds that IOT remains a good principle as 3GPP LTE will evolve with each release and thus requires continued revalidation of equipment at the IOT level as public safety usage ends up as a subset of standard commercial features.

Further the Commission opines that IOT "is critical to ensuring that public safety broadband networks are interoperable", "that no specific guidelines for conducting IOT between such networks have been developed", and that " in the interim, each public safety broadband network operator will be required to submit for Bureau review, within six months of its date of service availability, a plan for IOT. The scope of the IOT called

for in the network operator's plan would be required to be sufficiently broad to address all LTE capabilities and functions required under the Waiver Order, and it should examine all the interfaces needed for roaming to and from other public safety networks. After the Bureau approves its plan, each network provider will be required to certify, within three months, that IOT will be conducted on an ongoing basis with other deployed public safety broadband networks until final IOT testing rules are adopted." Cassidian adds that the Public safety IOT testing list is a subset of the commercial features list and thus the cost should be (for most part) a subset of Commercial IOT tests, and thus costs of the laboratories and tests suites may be similarly reduced. Cassidian also believes a national oversight for such testing review is required by the Commission possibly with the assistance of the PSCR.

iii. Interoperability Verification (§ IV.D.3)

The Commission asks if there are any "methods more reliable than IOT and conformance testing for verifying compliance with the technical requirements adopted for the nationwide network" and associated costs. Cassidian notes that, for verifying the compliance to a standard and testing interoperability, the conformance testing as described in the previous sections (e.g. PTCRB) and the IOT are the most appropriate methods.

W. Other Matters Relevant to Interoperability on Public Safety Broadband Network (§ IV.E)

i. Network Operations, Administration and Maintenance (§ IV.E.1)

The Commission states that "the Waiver Order did not address the technological and operational features of network operations, administration and maintenance

(OA&M). What operational capability, if any, should be required in order to maintain and enhance interoperability?" Cassidian notes if one deploys network infrastructure from different vendors that the OA&M is typically not compatible and this is addressed with global SNMP managers.

ii. Devices (§ IV.E.3)

The Commission notes current type approvals "that vary in terms of channel bandwidth, frequency bands and 2G/3G technology support" and asks comment on the following:

- ***Channel Bandwidth Requirement for the Public Safety Broadband Spectrum***
- ***Band Class 14 Support***
- ***Multiple Mode Support***

Cassidian comments that multiple channel support will increase the devices complexity and the following applies:

- Multimode implementation would be required (i.e. 2G, 3G) for roaming to commercial bands
- Multimode implementation requires multiple verifications (IOT)

Thus Cassidian believes that building too much into the devices for a small subset of the commercial market space will significantly increase the prices for these devices (i.e. development and verification costs) and thus full functioned multimode devices should be limited to a subset of the total public safety broadband device portfolio. Finally addition of such elements as "satellite" modes should not be required and be left as an option.

iii. In Building Communications (§ IV.E.4)

Cassidian has many years of experience in deploying public safety narrowband radio systems and notes for the Commission that there is no known mechanism to globally address building penetration. Current approach during the design phase is to identify critical structures in the coverage area (i.e. hospitals, schools, government buildings, areas, fire stations, etc.) and to then plan RF coverage to provide optimum outdoor signal levels to allow for penetration of that structure. In many cases testing of the structure in question may be required and in fact recommended. The goal is to minimize the number of in-building repeater systems in structures where tax dollars or building owners must fund the in-building system. A successful mechanism for commercial structures has been revision of building codes requiring that the new design and construction account for an in-building repeater system to ensure coverage.

iv. Deployable Assets (§ IV.E.5)

Cassidian agrees with the Commission that COWs and COLTs will be an important element of the public safety broadband network deployment. Cassidian further agrees that deployment of COWs and COLTs follow all established rules for coordination and operations. This is common practice today for both LMR and cellular systems and should not be an issue for the Commission nor should additional rules be imposed until such time additional rules are deemed necessary. Finally, due to the nature of temporary deployments, exclusive use of 4.9 GHz for backhaul may not always be the optimum solution and agencies should be free to choose the best backhaul solution for the situation. Cassidian notes public safety is already authorized to use 4.9 GHz for backhaul (i.e. point-to-point) and the use of satellite is an operational and cost decision.

v. Public Safety Broadband and Next-Generation 911 Networks (§ IV.E.8)

Cassidian believes that interface standardization is critically important to foster competition, control costs and promote adoption. Furthermore, a single comprehensive and open (non-proprietary) standard will be needed to realize the full potential and benefits associated with the transmission and receipt of non-traditional data types such as text, photos, and video. Most importantly, such a standard is absolutely essential to achieve full interoperability between the public safety broadband network and NG911 networks. For these reasons, Cassidian supports the National Emergency Number Association (NENA) i3 (Functional and Interface Standards for Next Generation 9-1-1, Standard 08-002 v1 and 08-003 v1) standard as the sole NG9-1-1 standard. To the greatest extent possible, this same standard should be employed within, or used as the basis for compatible standards employed within, the public safety broadband network as well. Compatibility and interoperability of the Public safety broadband network and NG9-1-1 networks should be repeatedly tested and confirmed through industry collaboration events similar to the ones now being sponsored by NENA.

CONCLUSION

Cassidian Communications, Inc. appreciates the opportunity to comment on the PS Docket 06-229 3rd Order and 4th Notice of Public Rulemaking and hopes the Commission will take into consideration Cassidian's views on this proceeding.

Respectfully submitted,

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APPENDIX

Additional Cassidian Comments on Incumbent Narrowband Operations

(§ IV.A.21)

Cassidian provides the following technical arguments to support Cassidian's assertions.

1. Specific features of the LTE air interface

Several features need to be mentioned in the context of coexistence between narrowband and broadband operation as they are specifically different from the narrowband to narrowband coexistence issues.

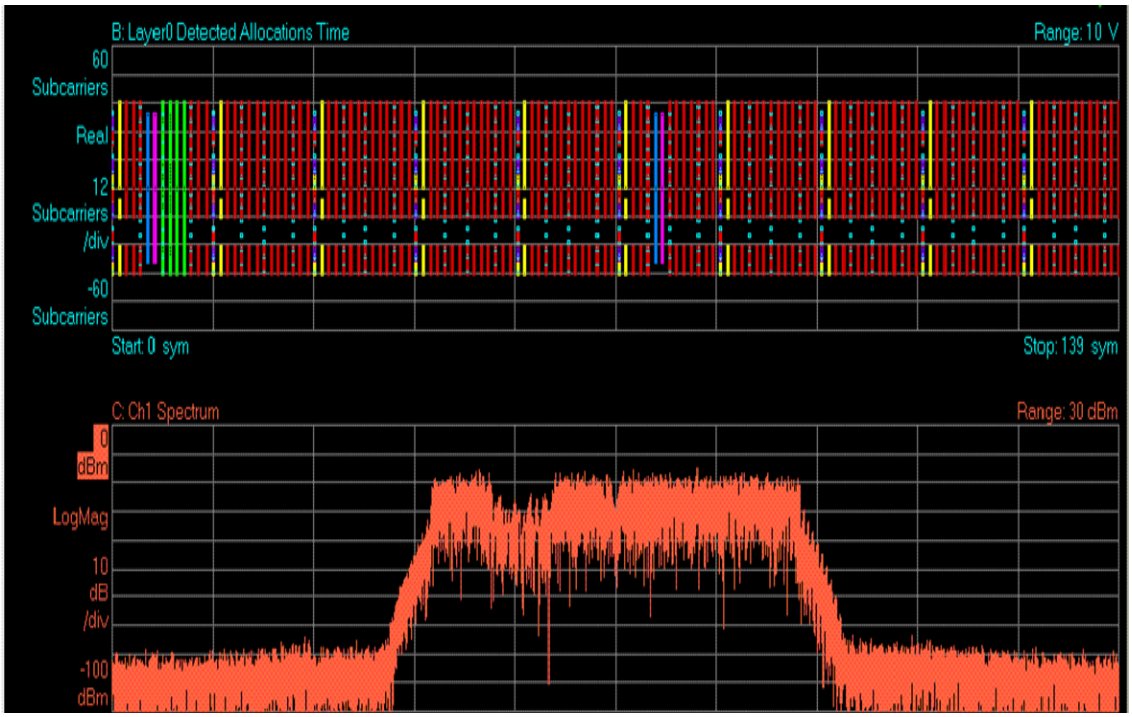
The first key difference is the significant difference in spectral power density. A typical narrowband transmitter – for example a P25 transmitter – will offer a transmit power of 15 Watts (after coupling losses and prior to antenna feed line/antennas) in a 6 kHz bandwidth. The corresponding power density will be 3.7 dBm/Hz (41.7 dBm – 38 dBHz). A broadband transmitter with transmit diversity and two 30 Watt transmitters in a 5 MHz channel, i.e. an effective 4.5 MHz transmit bandwidth will have a power density of -18.7 dBm/Hz (47.8 dBm – 66.5 dBHz), which is 22.4 dB lower than the corresponding narrowband power density.

A second key difference is the Signal to Noise Ratio (SNR) that may be allowed for proper reception. Telecommunications Industry Association (TIA) TSB-88 considers a signal to noise ratio of 16.5 dB as a proper working point for a P25 system and further consideration of all narrowband systems meeting the eligibility criteria for use in the 700 MHz band shows that the working point SNRs have the same order of magnitude, ranging between 12 and 22 dB. To the contrary, broadband working point as specified in the corresponding 3GPP specifications for LTE (3GPP TS 36.101 and 36.104) usually

have negative values in dB, at least for the control channels and the most robust data transport channels.

A further feature which is interesting in the narrowband versus broadband coexistence case is the ability provided by LTE to avoid at least partly the use of some frequency blocks, both for the downlink and for the uplink direction. When such use is avoided, the only active transmissions in the corresponding frequency blocks are those of broadcast information (synchronization and signaling) and pilot symbols, with low duty cycle and therefore lower power density. This further lowering of transmit power density may help provide protection to incumbent narrowband operations while keeping the transmit power level high enough in the other resources blocks to provide cost effective coverage for the Public Safety broadband operation.

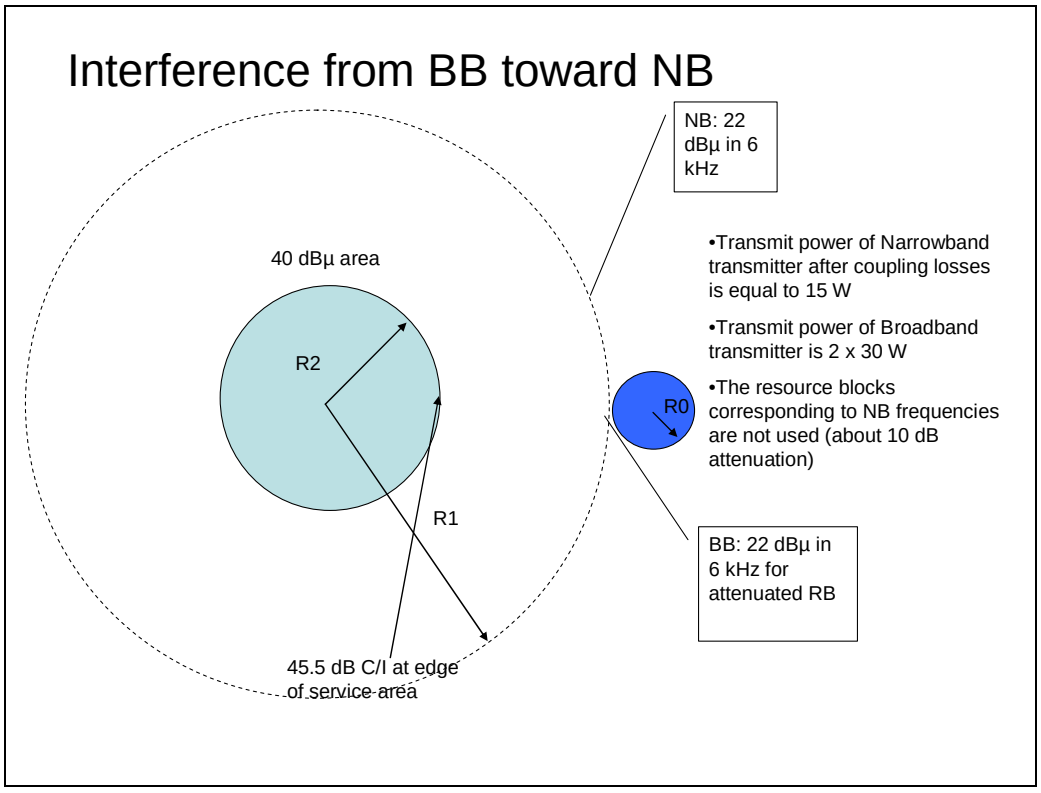
The following figure illustrates the corresponding LTE configuration.



As illustrated above, the power density in the frequency region corresponding to an unallocated Resource Block is more than 10 dB lower than the power density of the broadband carrier, averaged over its effective bandwidth.

2. Use of the 22 dBµ criteria

The figure below presents a coexistence situation where a narrowband transmitter is potentially interfered by a broadband transmitter. It is considered that the broadband transmitted is not allocating the Resource Block (RB) corresponding to the frequency of the incumbent operation and that the corresponding 22 dBµ transmit contours are non-overlapping.



To avoid any ambiguity, the 22 dBµ power is measured in the receive bandwidth of the

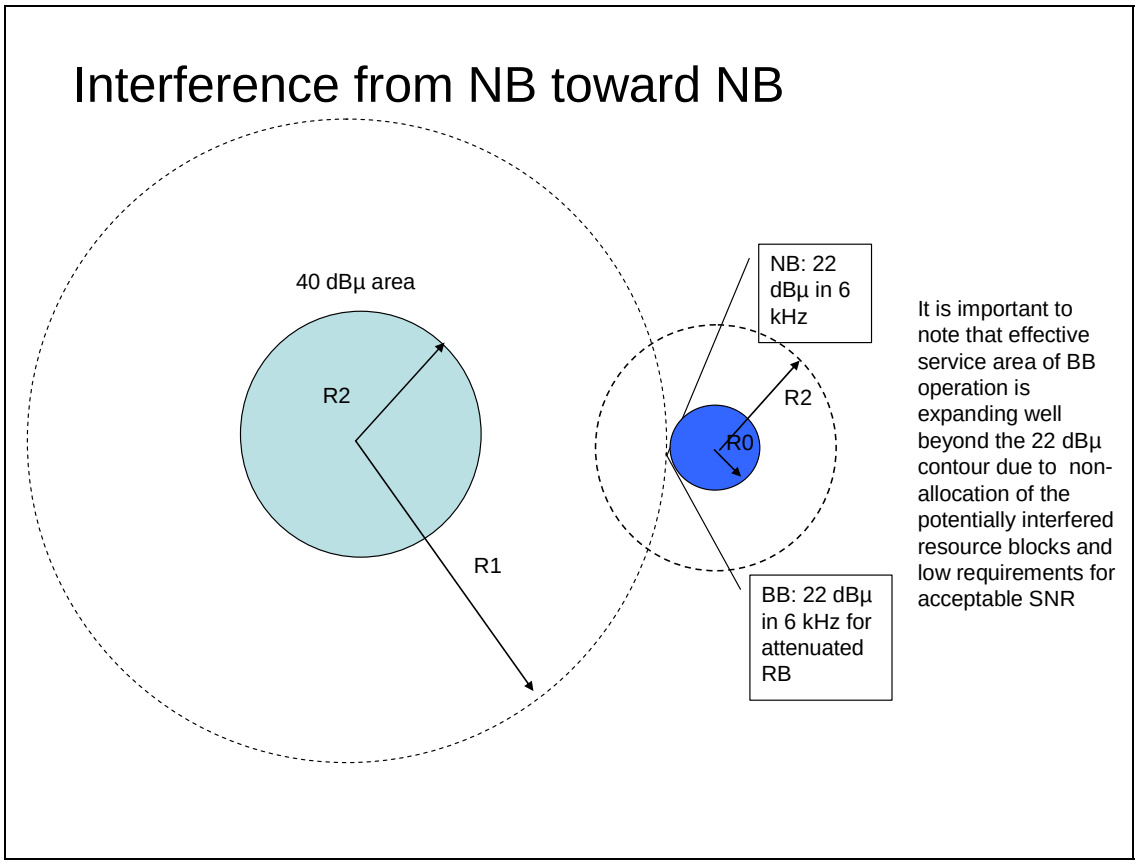
potentially interfered narrowband incumbent system, i.e. a 6 kHz bandwidth centered on the narrowband transmitter frequency.

We have further assumed that the narrowband transmitter power after coupling was 15 Watts and that the BB transmitter was an LTE transmitter in a 3 MHz channel (2.7 MHz active bandwidth) with a transmit power of 2 x 30 Watts (assuming transmit diversity). The propagation law is supposed to give an attenuation of 35 dB per decade.

Using these assumptions, the level of BB interfering signal measured through a 6 kHz filter will be -5.6 dBµ and the C/I ratio for the NB incumbent will thus be 45.6 dB.

There is thus such a high level of protection of the NB incumbent operation that it can be considered as fully protector from interference generated by the BB operation.

However, if we consider the following figure where a BB service area with a radius equal to the radius of the NB transmitter has been drawn, it is straightforward to verify that the received power in an allocated resource block will be equal to -98.4 dBm.



As the power per NB carrier is equal to -108 dBm on the service contour of the BB transmitter, there is no significant interference of the BB operation in this configuration, at cell edge, and even in the case where several incumbent narrowband carriers would be located in this same resource block.

We further note that these results which conclude that safe use of both narrowband operation and broadband is not contradicting the results outlined in the Telecommunications Industry Aassociation comments on Docket 06-229, submitted on December 3, 2010 which rightfully concluded that adjacent operation of the narrowband and broadband system was potentially unsafe as the 22 dBµ rule considered in this comment provides the appropriate buffer space to avoid harmful interference.

3. Conclusion

The computation of the level of interference, most importantly from a BB transmitter to an incumbent narrowband transmitter shows that the rule outlined in the comment made by State of Colorado, Governor's office of Information Technology provides safe and efficient operation of both systems pending the relocation of the incumbent narrowband systems.

To analyze this performance, one must consider the narrowband system filtering (for example 6 kHz) and that non allocation of some resource blocks of the LTE may be used to meet this criteria while still offering proper broadband coverage of the service area.